

Remarks

Claims 1-6 and 8-20 are pending in the subject application. By this Amendment, Applicants have canceled claims 1-6 and 8-20 and rewritten them as new claims 21-40. Support for the amendments can be found throughout the subject specification and in the claims as originally filed. Specifically, support can be found on, for example, page 15, lines 22-23; page 16, lines 1-11; and page 27, lines 20-24; and page 28, lines 8-10. Entry and consideration of the amendments presented herein is respectfully requested. Upon entry of the above amendments, claims 21-40 will be before the Examiner.

Claims 1-6 and 8-20 are rejected under 35 U.S.C. §112, first paragraph, for lack of written description purportedly because the exclusion of a cross-linked organic ligand has no basis in the specification. Applicants traverse this rejection because the skilled artisan would understand that the organic ligands, or the organic-inorganic composites, are not cross-linked when reading the specification in view of the prior art. There is no requirement that the claim terminology must be present verbatim in the specification. It is well settled in patent law that the claim language of an amendment need not be disclosed word for word in a specification. *In re Wilder*, 222 USPQ 369, 372 (Fed. Cir. 1984) ("It is not necessary that the claimed subject matter be described identically, but the disclosure must convey to those skilled in the art that applicant had invented the subject matter later claimed.") (emphasis added); see also MPEP §2163.02.

Applicants respectfully point out that the specification includes several schemes that illustrate the deactivation of the column at the inner surface and embodiments for the formation of the columns and methods of the claimed invention. A skilled artisan viewing methods to prepare sol-gel coatings that do use cross-linking reagents would understand that the resulting sol-gel coating could not possess a cross-linked organic-inorganic composite. The specification itself discusses the advantages of the claimed invention, one of which is its lack of free radical cross-linking reactions (page 28, line 14). The column would have no mechanism by which a polymer could cross-link. Thus, the specification provides a basis to exclude cross-linked organic-inorganic composites or ligands. Accordingly, reconsideration and withdrawal of the rejection under 35 USC §112, first paragraph, is respectfully requested.

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Claims 1-6 and 8-20 are rejected under 35 U.S.C. §103(a) as obvious over the Hayes *et al.* article (hereinafter 'Hayes *et al.* 1997') in view of Ogden *et al.* (1986) and Sumpter *et al.* (1990), and optionally Hayes *et al.* (hereinafter 'Hayes *et al.* 1996') and Wang *et al.* (1997). The Hayes *et al.* 1997 article fails to teach or suggest the claimed columns or methods of preparing the same. Hayes *et al.* 1997 pertains to a capillary electrophoresis (CE) column. Although the Hayes *et al.* CE column does possess a sol-gel coating, its sol-gel coating is inapplicable to columns of the claimed invention for the following reasons. First, the Hayes *et al.* 1997 coatings possess highly cross-linked polymers to prevent the analyte molecules from interacting with the solute, thereby reducing separation efficiency. Second, if the skilled artisan applies the Hayes *et al.* 1997 sol-gel coating to the gas chromatographic (GC) columns of the claimed invention, the highly cross-linked polymers would result in poor solute diffusion and mass transfer of the analyte molecules.

Third, the CE column is not used to separate moieties chromatographically. By its definition, a CE column possess only a mobile phase and takes advantage of migration rates of ionic liquid solutes when they are placed in an electric field. When these solutes are exposed to the inner surface of the column, any resulting interactions reduce the column efficiency. Any sol-gel coating applied to a CE column does not represent a stationary phase where separation takes place because a CE cannot have a stationary phase. As noted above, the sol-gel coating is applied only to prevent unwanted interactions between the solutes and the inner surface of the capillary. Fourth, the sol-gel coating of the Hayes *et al.* 1997 columns are deactivated at the tube surface; the residual silanol groups are merely shielded. In contrast, the deactivated stationary-phase sol-gel coating of the claimed invention is deactivated at both the inner surface of the tube and within the bulk of the coating (page 27, lines 19-22; page 28, lines 6-10; page 31, lines 1-10)

The Ogden *et al.* article fails to remedy the deficiencies of Hayes *et al.* 1997. For one, the skilled artisan would not combine the teachings of Hayes *et al.* 1997 with the Ogden *et al.* article because the individual columns rely on two distinct separation theories. Whereas Hayes *et al.* 1997 relies on the migration rates of various ionic liquid solutes, Ogden *et al.* uses its sol-gel coating as a stationary phase. As noted above, Hayes *et al.* 1997 fails to even have a stationary phase within its column.

Additionally, the combined teachings of Hayes *et al.* 1997 and Ogden *et al.* do not teach or suggest the claimed invention. As noted above, the claimed invention does not possess cross-linked elements. Both Hayes *et al.* 1997 and Ogden *et al.* both teach cross-linked sol-gel coatings of their individual columns. Additionally, the Ogden *et al.* article discloses a sol-gel coating whose deactivation takes place only at the surface of the capillary (pages 16-7). In contrast, the claimed column, advantageously, possesses a deactivated sol-gel coating, which encompasses both the deactivation at the tube inner surface and throughout the coating.

Regarding the methods of the claimed invention, the Ogden *et al.* article relies on a multi-step approach in the preparation of its columns, wherein the deactivation step takes places separately from the immobilization step (pages 11-3). In contrast, the stationary phase of the claimed invention is created, coated, immobilized, and deactivated in one step.

Again, the skilled artisan is unlikely to combine the teachings of Sumpter *et al.* with Hayes *et al.* 1997. Sumpter *et al.*, similar to Ogden *et al.* discussed above, pertains to chromatographic columns (gas and supercritical fluid). The skilled artisan has no motivation to combine the teachings of a separation column based on chromatography with a separation column based on migration rates of ionic liquid solutes. As noted above, sol-gel coatings in chromatographic columns are used as a stationary phase where the separation takes place. In contrast, the sol-gel coating in Hayes *et al.* 1997 is used to prevent interactions between the column and the solute.

Initially, even if the references were properly combinable, the combination of Hayes *et al.* 1997 in view of Sumpter *et al.* or the combination of Hayes *et al.* 1997 in view of Ogden *et al.* and Sumpter *et al.* fails to teach each and every element of the claimed invention. Regarding the method claims, the combination of references fails to teach a preparation of a sol-gel coating wherein the creation, the coating, the immobilization, and the deactivation take place all in one step. Specifically, the methods disclosed in the cited references are multi-step preparations.

Regarding the columns itself, the combined references again fail to teach a column with a deactivated sol-gel coating. As noted above, Hayes *et al.* 1997 only deactivates at the surface while shielding any residual sites within its column, and both the Ogden *et al.* and Sumpter *et al.* only teach deactivation at their respective column surfaces. Thus, the combination of references fails to

teach or suggest a GC column with a sol-gel coating stationary phase coating that is deactivated at both the inner surface and within the coating.

The Wang *et al.* reference also fails to remedy the short-comings of Hayes *et al.* 1997. For one, the Wang *et al.* reference is directed to a non-aqueous preparation for a sol-gel coated GC column. In contrast, the Hayes *et al.* 1997 column is directed to an aqueous preparation for a sol-gel coated CE column. Wang *et al.* teaches against aqueous preparation of GC columns (page 507). Accordingly, a skilled artisan is unlikely to combine the teachings from an non-aqueous GC column with the teachings of an aqueous CE column to arrive at the claimed invention. Moreover, the skilled artisan understands that due to the innate differences in aqueous prepped GC columns and non-aqueous-prepped columns, the resulting column performs inefficiently if at all (see, for example, Figure 2 from Wang *et al.* vs. Figures 31 and 36 of the subject application). In contrast, the columns of the claimed invention unexpectedly show separations that are narrow and without the tailing shown in the Wang *et al.* column. Evidence supporting this superior separation column can be found throughout the instant application including, for example, Figures 7-39.

The Hayes *et al.* 1996 reference also fails to remedy the short-comings of the Hayes *et al.* 1997 reference. First, Hayes *et al.* 1996 fails to suggest or teach a gas chromatography column having the deactivated surface coating of the claimed invention. The teachings of Hayes *et al.* 1996 apply to a CE column (page 497, lines 32-33). As noted above, the coating in a CE column is used to prevent unwanted interactions between the analyte and the column surface. The CE coating does not function as a stationary phase or a mechanism by which separation takes place. Moreover, Hayes *et al.* 1996 only discusses sol-gel techniques as they have been applied to capillary electrochromatography, capillary electrophoresis, and open tubular liquid chromatography (page 500, lines 4-7). It provides no suggestion that a sol-gel coating could be applied to a GC column to separate gas phase moieties.

Second, Hayes *et al.* 1996 fails to suggest that the coating could be prepared in the presence of water. The preparation steps explicitly avoid the use of water or even components having hydrated water molecules. The only disclosure for an aqueous preparation is with respect to a packed column. In contrast, the claimed invention pertains to coated columns. There is no need for

11

Docket No. USF-221XT  
Serial No. 09/763,419

a packing in the aqueous prepared columns of the claimed invention. Thus, the deficiencies of Hayes *et al.* 1997 are not remedied by the teachings of Hayes *et al.* 1996.

Accordingly, reconsideration and withdrawal of the rejection under 35 USC §103(a) is respectfully requested.

It should be understood that the amendments presented herein have been made solely to expedite prosecution of the subject application to completion and should not be construed as an indication of Applicants' agreement with or acquiescence in the Examiner's position. Applicants expressly reserve the right to pursue the invention(s) disclosed in the subject application, including any subject matter canceled or not pursued during prosecution of the subject application, in a related application.

In view of the foregoing remarks and amendments to the claims, Applicants believe that the currently pending claims are in condition for allowance, and such action is respectfully requested.

The Commissioner is hereby authorized to charge any fees under 37 CFR §§1.16 or 1.17 as required by this paper to Deposit Account No. 19-0065.

Applicants invite the Examiner to call the undersigned if clarification is needed on any of this response, or if the Examiner believes a telephonic interview would expedite the prosecution of the subject application to completion.

Respectfully submitted,



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